Coronal Heating and Solar Wind Acceleration

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A new scenario on the coronal heating and the accelerations of the solar wind is presented. This is based on the DC injection of the energy flux as the twisting magnetic field coming from faculae. The twist in the corona will produce charge separation and consequently electric field parallel to the magnetic field. Accelerated beam electrons due to the latter electric field will be stopped by classical collisions with ambient electrons and ions. The beam electrons do not create electric currents due to the back streaming bulk electrons so that the proposed heating is not the Joule heating, nor anomalous Joule heating, but a co-spatial frictional heating. The heating rate is $H_{beam} = m_e n_b V_b^2 \nu \approx$ a few times 10^{-4} erg cm^{-3} s^{-1}. Here m_e is the electron mass, n_b number density of the beam electrons (roughly 10^{-3} of the electron density), V_b velocity of the beam electrons of typically 2 - 3 times electron thermal velocity, and ν collision frequency of beams of 14 s^{-1}. This heating rate is sufficient to heat the closed loop and to accelerate the solar wind plasma flow in an open field. This heating rate succesfully reproduces the observed scaling laws in both quiet and active regions. Though the radii of the coronal loop are not a critical parameter unlike in the Joule heating, they are in the range between 1000 km (coming from the 0.3" faculae), and 10 km (coming from the critical radius inside a facula between frozen and non-frozen).

Since the heating is larger in the lower corona, closed loops are expected to be thermally unstable, and to repeat evaporation and draining down after cooling like recurrent small thermal flares. Namely, in the closed loop, the coronal heating is excessive. On the other hand in the open field, this excessive heating produces evaporative plasma upflows. The heating will remain appreciable up to several solar radii. We find that the terminal velocity of the wind is prefixed deep in the corona and not by interplanetary conditions. Since we identified the dissipative process of the twisting, H_{beam}, to create a high speed wind becomes basically possible.